Development and Implementation of a Robot-based Freshman Engineering Course

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http://www.coe.montana.edu/ee/maher/ee101/ECEbot/

Course Format

1. Develop a compelling opportunity for students to learn circuit theory, characteristics of standard electronic components, and electrical laboratory measurement procedures.
2. Capture the imagination of first-year engineering students: instill in them a feeling of accomplishment and confidence in their technical abilities.
3. Raise awareness of electrical and computer engineering career opportunities among potential students throughout the Region.
4. Document the project so that the robot design and educational materials can be sustained at Montana State University and disseminated to other institutions.

Objectives

1. Prepare supplementary and follow-on materials
2. Provide sufficient equipment and supervision in the lab
3. Try to adopt existing building blocks and components
4. Secure "buy-in" from faculty colleagues
5. Involve students in the development process

Lab #1: Batteries, Power Supplies, and Resistors
- Breadboards, resistor strips
- Batteries: 7 AA Batteries
- Resistors: OHM to measure voltage and resistance; Ohm’s vs. measured values; Parallel and series resistors; Battery and power supply

Assembly: none

Lab #2: Ohm’s and Kirchoff’s Circuit Laws
- Breadboards, resistor strips
- DC Servo Motors (2)
- Test probes; meter
- CA and CH: Measuring DC voltage and current; Potentiometers; Circuit board assembly methods: component placement and soldering
- Assembly: solder steps 1 and 2 (soldering on socket and power system)

Lab #3: AC Signals and the Oscilloscope
- Platform: breadboards, resistors, capacitors
- Function Generator: Pulse generator for AC signal types
- Oscilloscope: using the oscilloscope to compare AC signal types and experiment with the basic features of Matlab (entering numeric sequences, arithmetic, plotting)
- Assembly: complete circuit assembly and breadboard

Lab #4: Digital Signals
- Platform: breadboards, beginning-assembled robot PCBs
- Assemble: breadboards, 4-digit 7-segment display

Lab #5: Robot Board Sub-System Testing
- Platform: breadboards, 4-digit 7-segment display
- Assembly: none

Lab #6: Introduction to MATLAB
- Platform: complete robot
- Assembly: none

Lab #7: Microcontroller and Motor Testing
- Platform: complete robot
- Platform: PC in computer lab
- Assembly: complete circuit assembly and breadboard

Lab #8: A/D Converter and ECEbot Bumpers
- Platform: complete robot
- Assembly: none

Lab #9: MATLAB for EE problem solving
- Platform: PC in computer lab
- Topic: Solving simultaneous equations; Representing circuits and components
- Assembly: none

Lab #10: Control and Motion Sequencing
- Platform: Breadboards, resistors, capacitors
- Topics: Define a sequence of commands to navigate a small obstacle course
- Assembly: none

Lab #11: Final course navigation event
- Platform: Breadboards, resistors, capacitors
- Topics: Motion sequencing contest
- Assembly: none

Assessment

1. 88% of the students reported that their interest and enthusiasm for electrical engineering was increased by the robot project.
2. 89% reported that they gained practical and useful knowledge in the course.
3. 54% felt that the course had given them more confidence in their ability to succeed in engineering.

Recommendations

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